

# Introducing the e-navigation revolution

Your input is needed to make it effective

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E-navigation is *'the collection, integration and display of maritime information aboard and ashore by electronic means to enhance berth-to-berth navigation and related services, safety and security at sea, and the protection of the marine environment'*: definition from the International Association of Marine Aids to Navigation Lighthouse Authorities (IALA).

This is an ambitious concept – nothing less than that existing and new navigational tools can be integrated in an all-embracing system that will make a uniquely important contribution to enhanced navigational safety and commercial efficiency.

David Patraiko chairs the IALA E-navigation Operators Working Group, and represents The Nautical Institute on the IMO E-navigation Correspondence Group. In this article he outlines the background to what is an important and complex development. And as he writes, it is vital that seafarers give their views at this stage, to help shape the way e-navigation grows and to make sure it works for them.

In December 2005, Japan, the Marshall Islands, Netherlands, Norway, Singapore, UK and USA submitted a paper (MSC 81/23/10) to the IMO Maritime Safety Committee on the development on an e-navigation strategy. This was proposed to add a new item on e-navigation to the work programmes of the NAV (Safety of Navigation) and COMSAR (Radio communications and Search and

Rescue) Sub-committees. The paper went on to propose that the aim should be to develop a strategic vision for the utilisation of existing and new navigational tools, in particular electronic tools, in a holistic and systematic manner. E-navigation, the paper argued, would help reduce navigational accidents, errors and failures by developing standards for an accurate and cost-effective system that would make a major contribution to the IMO's agenda of safe, secure and efficient shipping on clean oceans. MSC 81 agreed that the two sub-committees should consider the issues with the aim of developing a 'strategic vision' within their associated work programmes to progress this issue and reporting to MSC 85 in 2008. It is towards creating this strategic vision by 2008 that the industry, and international bodies like IALA and the International Hydrographic Organisation (IHO), are now focused.

Following this meeting of the MSC, on 22 May 2006, Efthimios Mitropoulos, Secretary-General of the IMO (and Honorary FNI) addressed the issue of e-navigation in his keynote address to the quadrennial IALA conference in Shanghai. An extract from this address clearly illustrates the concepts and ambitions for e-navigation: see pp 7-8.

## Making progress

Subsequently in July 2006, e-navigation was added to the NAV 52 work programme and initial discussions were undertaken. The main outcome of these preliminary discussions was the decision to establish a Correspondence Group, coordinated by the UK, and instructed to report back to NAV 53 (July 2007).

The group was issued terms of reference to consider and asked to provide comments and make recommendations on the following:

■ 1. The definition and scope of the concept of e-navigation in terms of its purpose, components and limitations and to produce a system architecture;

■ 2. The identification of the key issues and priorities that will have to be addressed in a strategic vision and a policy framework on e-navigation;

■ 3. The identification of both benefits of and obstacles that may arise in the further development of such a strategic vision and policy framework;

■ 4. The identification of the roles of the IMO, its member states, other bodies and industry in the further development of such a strategic vision and policy framework;

■ 5. The formulation of a work programme for the further development of such a strategic vision and policy framework, including an outline migration plan and recommendations on the roles of the NAV and COMSAR Sub-committees and the input of other parties concerned.

There are many groups and organisations nationally and at an international level which are coordinating and providing input to the IMO. One of these is the newly formed IALA E-navigation Committee, launched during the Shanghai conference mentioned earlier and with a four-year work programme. IALA will use this dedicated committee of international delegates, representing practitioners and technical experts to build on its expertise in the fields of aids to navigation and VTS to contribute significantly to the concept of e-navigation through the IMO.

In September 2006, the IALA committee met for the first time. After discussing the wide range of options and benefits that could become part of e-navigation, it agreed that its primary value was to join the ship's bridge team and VTS team to create a unified navigation team that would achieve safer navigation through shared tactical information. For full implementation and effectiveness of such a system, it would need to be mandatory for Solas vessels and scaleable to all users.

The committee was united in the belief

that before any primary benefits or value added services could be realised, an architecture comprising three fundamental elements must first be put in place.

- World electronic navigation chart (ENC) coverage of navigational areas;
- A robust electronic positioning system (with redundancy); and
- An agreed infrastructure of communications to link ship and shore.

Considering the human element issues, the following need to be taken into account while developing an e-navigation strategy:

- Man/machine interface (balance between standardisation and leaving room for innovation and development);
- Modes of information display/portrayal;
- Appropriate communication of situation awareness;
- Onboard e-navigation system equipment should be designed to engage the bridge team and maintain high levels of attention and motivation without causing distraction.

Building on this concept the Australian Maritime Safety Authority (AMSA) held an

e-navigation workshop in November 2006 and produced an architectural diagram to complement the work of IALA and contribute to the IMO CG: below.

This diagram clearly shows that communication between the ship and shore navigation teams is at the core of e-navigation, that there can be a wide range of inputs into such a system but two very clear outputs; safe navigation and improved efficiencies of operation.

## The Institute's initiative

In December of 2006 The Nautical Institute held a special e-navigation meeting with the specific objectives of bringing seagoing council members together with leading manufacturers and regulators involved in the concept of e-navigation.

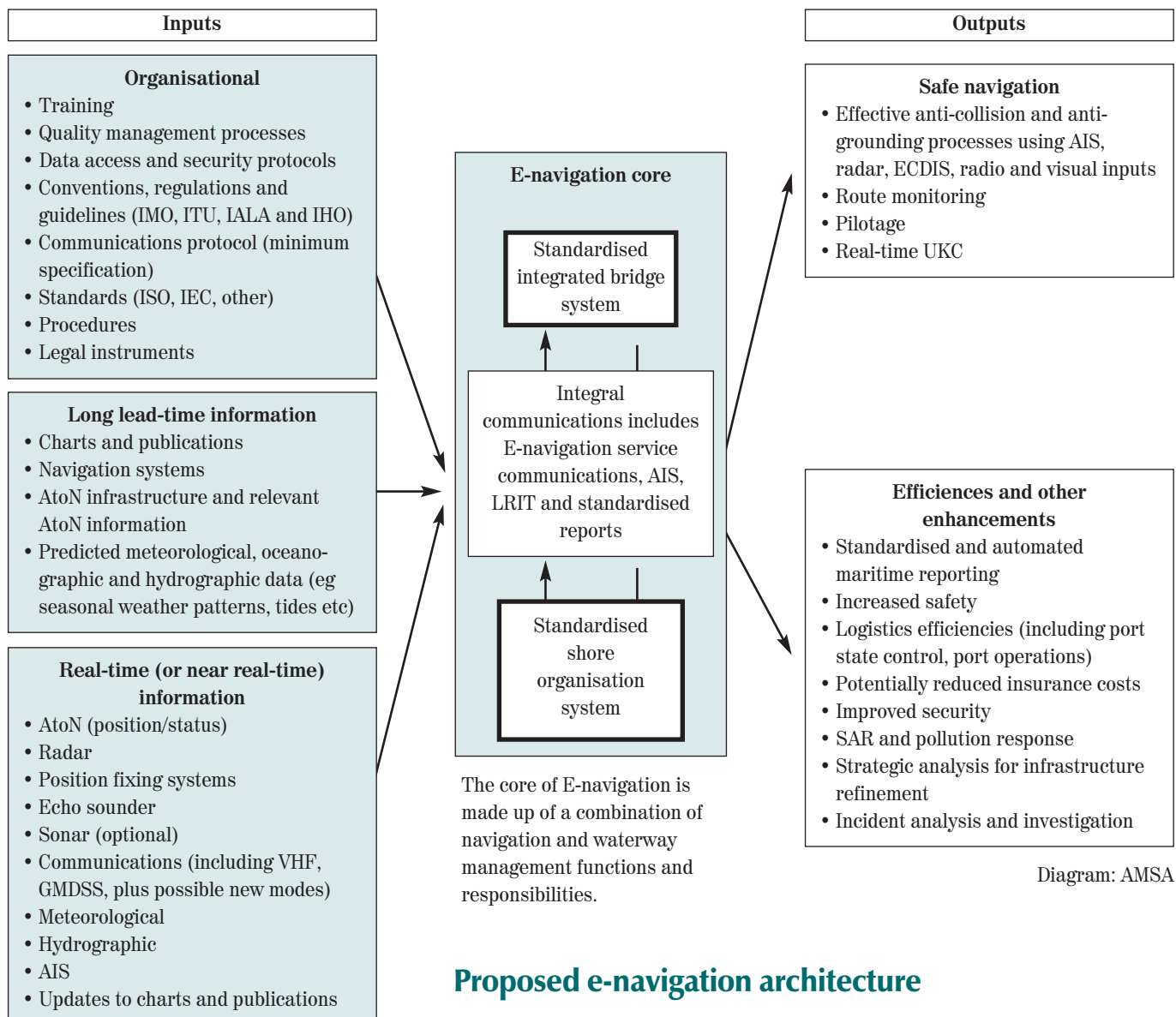
At this meeting it was stated that 'although the official concept of e-navigation is still in its infancy and only loosely defined, we recognised that the amount of energy and interest shown by the maritime

community offers us an opportunity to make a positive impact on the way vessels are navigated in the future'.

We saw some cutting edge technology such as the bridge systems developed by L-3 Marine, the Kelvin Hughes 'new technology' radar, and listened to an explanation of e-Loran from Dr Sally Basker. We heard from Lloyd's e-Register about how alarms could be better managed and had a rather heated debate about how important alarm management was, which will result in the NI investing more time and effort into this issue. Dr Andy Norris CNI also drove home the necessity for any future systems to be of 'high integrity' if they are going to be relied upon.

We were pleased to have representatives from IALA, the UK DfT (coordinators of the IMO Correspondence Group), UK Maritime and Coastguard Agency (MCA), General Lighthouse Authorities, (GLA), International Electrotechnical Commission (IEC),

*Continued on p8*



## Proposed e-navigation architecture

# E-navigation: a global resource

**Efthikios Mitropoulos Hon FNI**  
Secretary-General, IMO

**T**here is no doubt that we are now entering a crucial stage in the development of what has become known by the catch-all designation of e-navigation. Many of the building blocks are in place but what is still in an embryonic state is the global strategic vision needed to ensure that the new generation of navigational tools, available to us now and in the near future, can be drawn together in a holistic and systematic manner, into an all-embracing system. If we get this right, we have the opportunity to secure not only a greater level of safety and accident prevention but, at the same time, deliver substantial operating efficiencies with consequent commercial benefits.

Although it is difficult, at this stage, to be precise about the full extent of the changes that might be necessary to realise fully a vision of e-navigation, it seems reasonable to assume that they will be extensive and fundamental. As well as IALA's world of aids to navigation, the whole gamut of shipboard navigational tools is on the brink of revolution and the impact of this is likely to be felt in working methods and practices, personnel training, communications and the shoreside infrastructure. It is also very likely that, as the overall strategy for e-navigation becomes clearer, there will be implications for the international regulatory framework, and I can assure you that IMO stands ready to address this issue and deal with it effectively when the time comes.

There seem to be clear advantages in the development of e-navigation that will contribute to enhanced navigational safety (with all the positive repercussions this will have on maritime safety overall and environmental protection) while simultaneously reducing the burden on the navigator.

The array of electronic navigational and communication technologies and services already available or in development is extensive. We are all now familiar, to a greater or lesser extent, with the likes of AIS, electronic chart display and information systems (ECDIS), integrated bridge systems and integrated navigation systems – (IBS/INS), automatic radar plotting aids – Arpa, radio and satellite-based navigation systems, long-range identification and tracking – (LRIT), VTS, wireless digital data communication networks and the global maritime distress and safety system – (GMDSS).

Not only do these technologies hold the promise of reducing navigational errors and accidents, they also have the potential to deliver benefits in other ways. Search and rescue, responding to pollution incidents, ship and port security and the protection of critical marine resources, such as fishing grounds, are among those that spring readily to mind. They can also offer operational benefits: imagine the potential of a system that can make detailed information on vessel and cargo arrival available in advance; or the ability to ease throughput and thereby effectively increase capacity in ports, fairways and waterways suffering from chronic congestion or simply poor visibility – it would be invaluable.

My concern, however, is that technological advances of this kind must be developed in a coordinated and structured manner, which is why I am particularly pleased that organisations such as IALA are now looking at these developments from a broader perspective; beginning to identify what part they can play in them and how they can collaborate with others to produce solutions from which all will benefit.

A lack of standardisation both on

board ships and in shoreside infrastructure (with its attendant problems of incompatibility either between vessels, or between vessels and shore-based facilities) and increased and unnecessary levels of complexity, clearly has to be avoided. There are many potential stakeholders in this; as well as specialist organisations such as IALA and, I have no doubt, IHO, the likes of equipment designers and suppliers, shipowners and the port industry, not to mention those who actually practise navigation, all need to be involved in the process.

A prime requirement is for accurate, comprehensive and up-to-date electronic navigational charts, covering the entire geographical area of a vessel's operation. These need to be combined with accurate and reliable electronic positioning signals and with fail-safe backups, probably provided through multiple redundancy; using, for example, a combination of the several systems that exist today or will soon be available, such as GPS, GLONASS, Galileo, Loran C or even onboard inertial navigation devices. A further prerequisite is information on the vessel's route, course, speed, manoeuvring parameters and other vessel status items such as the ship's identity, passenger details and/or cargo type and security level etc, again in electronic format.

Any such system should also incorporate the transmission of positional and navigational information in several directions: ship-to-shore, shore to ship (by the likes of VTS centres, coastguard and SAR facilities and hydrographic offices), as well as ship to ship. All this information would have to be displayed clearly, accurately and in a user-friendly manner both aboard ship and ashore. In risk or danger situations, simple and effective prioritisation of information

(something like information on a 'need to know' basis) would also be a key requirement.

No one can doubt the compelling need to equip ships' masters and others responsible for safe shipping with the very latest tools to make navigation – and maritime communications – more reliable and thereby to reduce errors, especially those with a potential for loss of life, injury, environmental damage and undue commercial costs. More substantial and widespread benefits for states, shipowners and seafarers can be expected to arise from the increased safety at sea, which should be the core objective of e-navigation.

As the necessary core and ancillary technology is already available, the challenge lies in using it effectively in order to simplify the display of the local navigational environment to the mariner. It is, therefore, important that any integrated navigation or decision-support system be designed so as to relieve the officer of the watch from some of the burdens of watchkeeping while, at the same time, be sufficiently intelligent to filter out some of the less crucial information and not draw the navigator into a false sense of security by over-reliance on the equipment or the information presented.

The design of the system should not reduce the navigator solely to the role of monitoring the system, but enable him or her to obtain optimum navigational support and information from it to facilitate and ensure appropriate and timely navigational

and anti-collision decision-making in accordance with good seamanship. This is a crucial factor if we are not to introduce more 'technology-assisted' collisions or groundings.

It is equally crucial, therefore, that effective, possibly even ship-specific, training be devised and delivered to make certain that optimum use is made of an integrated e-navigation system designed to benefit navigational safety and environmental protection, while simultaneously reducing the burden on the navigator. However, irrespective of how sophisticated the technology and the training, the obligation will always remain with the officer of the watch to comply with the Collision Regulations and 'maintain a proper look-out by ... all available means ... so as to make a full appraisal of the situation and of the risk of collision'.

The digital revolution in information and communication technologies (ICTs) has created the platform for a free flow of information, ideas and knowledge across the globe. This is already impacting the world in deeply intrinsic ways, perhaps even more profoundly than the industrial revolution itself. For example, the internet has become an important global resource, one that is critical to both the developed world as a business and social tool and the developing world as a passport to equitable participation, as well as economic, social and educational development.

Yet, while the digital revolution has extended the frontiers of the

global village, the vast majority of the world remains unhooked from this unfolding phenomenon. This has created what is known as the 'digital divide', or the gap that separates those who are connected to the digital revolution in ICTs and those who have no access to the benefits such new technologies generate.

To bridge the divide, the United Nations has pursued the objective of agreeing principles and plans of action leading the world to an all-inclusive and equitable 'information society'; one in which the benefits derived from ICTs are accessible to all and promote the use of e-strategies, e-commerce, e-governance, e-health, e-trade, education, literacy, cultural diversity, gender equality, sustainable development and environmental protection. In other words, the objective is to generate information and communication benefits that will help us all towards the fulfilment of the millenium development goals.

In pursuing our dream of e-navigation, we must not lose sight of the needs, the capabilities and the potential of the developing world and, to harness that potential, we should act in tandem with it. Developing countries should be involved in the process at an early stage and their nationals should be made aware of what is going on. We should endeavour to bring them on board and, at IMO, we should engage them in all phases of the development of the e-navigation concept. I am certain they will be able to contribute satisfactorily.

manufacturers, trainers, pilots, military and merchant mariners, all eager to work together to develop the best possible future systems. We were also reminded, by the sailing mariners often and passionately, to keep things simple, make best use of standardisation and to put a high priority on training.

## S-mode: feedback needed

Armed with this advice, the NI vowed to continue to work with all stakeholders in the industry to represent the professional views of mariners, towards developing a future navigation system to improve safety and efficiency. Copies of these

presentations are available to members on request to: [djp@nautinst.org](mailto:djp@nautinst.org)

These discussions, brought us back to a recurring theme from the series of integrated bridge systems (IBS) conferences the Institute held in 2002 and 2003. There the debate often centred on the need and advantages of standardised controls and presentation, and the advantages and need for the manufacturers to drive innovation. One outcome from these conferences was the desire for an IMO-approved default setting that could be triggered by a single button. Although the mariner/display interface is only one aspect of e-navigation, it is an important one.

This general concept has now evolved

into what we are arbitrarily calling the 'S-mode' of operation and we would like readers of *Seaways* to provide some feedback on the idea before the NI develops it further.

It is recognised that there is a vital need to embrace new technology and for manufacturers to be able to innovate with the expectation that if they get it right, they will be rewarded with sales of their products. Recent innovations include the chart radar; new technology (NT) non-magnetron radar; and ECDIS, to name just a few. Significant innovations from the past have included electronic position fixing systems, the gyro compass and even the chronometer in its day. Standardisation of

navigation displays on the bridge would simplify training and ensure that pilots and mariners could be instantly familiar with the operation of such equipment when joining a vessel and therefore be better placed to concentrate on making good decisions. The question therefore is how to balance these two objectives.

The concept of S-mode builds on the concept of a default setting by being a 'default mode'. This mode is made possible by the increasing use of multi-function displays (MFDs) where radar, charts, electronic position systems etc are inputs that can be arranged or re-arranged in any form on a display.

S-mode would require all navigation displays, regardless of manufacturer, to have a clearly identified button that, when pressed, brings the display into a standard format with a standard menu/control system, standard interface (keyboard/joystick etc) and basic features. For example, there may have to be a tactical display for near-time decisions (collision, and hazard avoidance) and a complementary display for voyage planning. At the press of a button the tactical display might revert to a 12-mile range radar view with targets showing relative vectors; and perhaps hazardous depth contours shown from vector chart data, such as used on a chart radar. This view would be standardised and familiar to all pilots and mariners and then could be manipulated through a standard menu system for a limited, although adequate, functionality. The advantage to this would be that:

- Training for S-mode could be standardised throughout the world.
- Any mariner or pilot would be comfortable reverting to S-mode and be competent in using the system's layout and functionality, regardless of manufacturer.

- Masters or companies could impose S-mode only use by crews until such time that they have proven they are competent to use further functionality that may have been provided by individual manufactures.

- S-mode could also be used at times when the bridge team is made up of multiple persons who need to share a common display for decision making.

With the performance of S-mode secured and strictly governed by the IMO, manufacturers would be able to develop further functionality that they could market to shipowners as a 'value added' feature. If, in time, these innovative features proved to be popular and effective, they could then be brought into S-mode in a controlled way by the IMO.

At a basic level, some ships might opt to only have S-mode functionality installed: however there may be other vessels which by the nature of their trade or quality of their training can take advantage of new and innovative features that would be developed by the industry.

## Conclusion

E-navigation is, at the moment, a catchall phrase for a concept of bringing existing and new technologies together to improve safety of navigation, commercial efficiency and security. The challenge for the industry, working through IMO, will be to produce a unified strategy for this integration and then (and only then) to develop specific systems to meet the needs. This is no small feat. Chart data and systems need to be brought to an agreed standard; position fixing systems need to be of high integrity; communication systems need to be established that meet the needs of e-navigation with agreed technology, protocols and payment plans. This all needs to be achieved with an

acceptable cost/benefit balance.

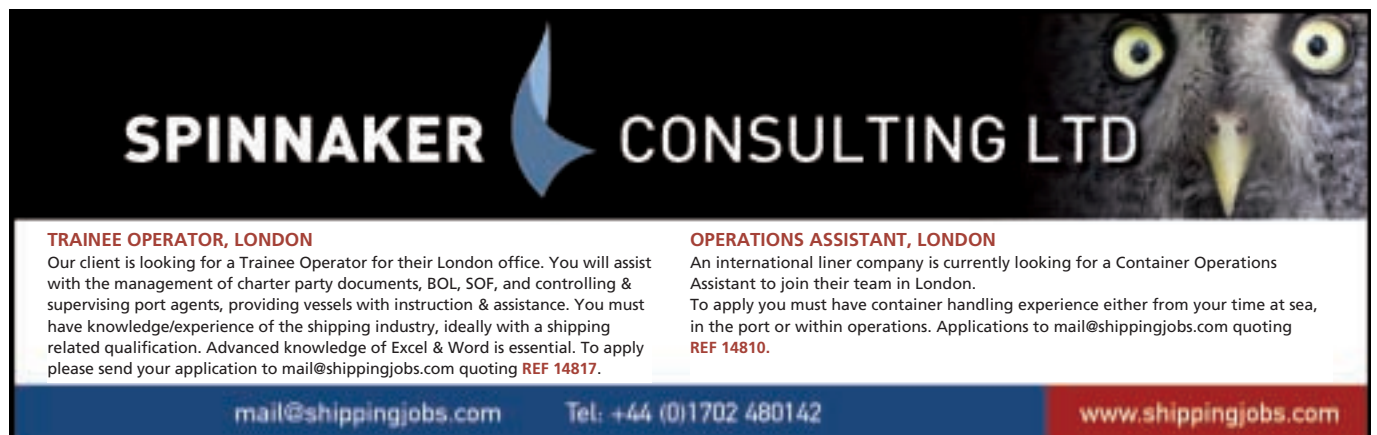
To my mind, implementing technology is like a three-legged stool: if any one or more legs is inadequate, the whole system fails. Here, one leg is the technology itself, another is the procedure for how to use the technology (gained through testing and experience) and the final one is training, both in the operation of the technology itself but most importantly in using the technology with agreed procedures to make good decisions.

The concept of e-navigation, as outlined in this article, is a worthwhile and essential goal that we should embrace. However we should be aware that 'electronic navigation' is with us already and flourishing, led by commercial developments. Systems already exist that have high levels of integration both onboard and via communication links to shore, and this will continue to develop regardless of the work of the IMO. E-navigation, however, gives us a chance to bring this development within a strategic vision.

The Secretary General of the IMO has stressed the need for 'those who actually practice navigation' to be involved in the development of e-navigation, and The Nautical Institute is committed to working with our members to participate in this essential task.

This is a fledgling idea and The Nautical Institute seeks feedback from all *Seaways* readers. If it is seen to be worthwhile, the functionality of S-mode will have to be established, and the Institute will work with various stakeholders to develop this.

Feedback on the initiative, either as a concept or with specific suggestions for format, should be sent to [djp@nautinst.org](mailto:djp@nautinst.org)



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